

EM313 Materials Science

United States Naval Academy Mechanical Engineering Department

EM313 Materials Science

Catalog Description: EM313 Materials Science

Credit: 4 (3-2-4)

An introductory course in physical and mechanical properties of engineering design materials, ceramics and plastics, their structures, use in engineering applications and failure phenomena. All laboratory projects are structured to provide strong physical illustrations for the topics covered in the lectures.

Prerequisites: Strength of Materials

Corequisites: None

Textbooks: William D. Callister, Materials Science and Engineering, 5th Edition
Library Reserve Materials *On Reserve in Nimitz Library*

Course Director: Associate Prof. Angela Moran

Objectives¹:

1. To apply the aspects of material selection in engineering design. (a,b,c)
2. To explain the relationship between microstructure of engineering materials and the mechanical and physical properties of these materials. (a,b,c,d)
3. To describe the mechanical properties of engineering materials which influence material selection decisions and to explain the various testing methods for evaluating mechanical properties. (a,b,c)
4. To determine how thermal and mechanical processing influence, and can be used to control, the microstructure and properties of engineering materials. (a,b,c)
5. To evaluate how the environment can influence the structure and properties of engineering materials. (a,b,c)
6. To describe various types of material failure and to present procedures to avoid them. (a,b,c)
7. To demonstrate in the laboratory some of the more common basic tools used to characterize the structure and properties of engineering materials. (a,b,c,d)

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Course Content:

No.	Topic or Subtopic	hrs.
1	Materials Selection	1
2	Atomic Bonding	2
3	Crystal Structure	3
4	Defects/Microscopy	2
5	Diffusion	2
6	Mechanical Properties	4
7	Strengthening/Annealing	3
8	Fracture/Fatigue/Creep/Fractography/Impact Testing	4
9	NDE	2
10	Solidification, Casting and Welding	4
11	Phase Diagrams, Phase Transformations, Thermal Processes	10
12	Other Alloys	4
13	Ceramics	2
14	Composites	3
15	Polymers	2
16	Corrosion and Wear	3

Evaluation:

1. Quizzes
2. Exams
3. Homework
4. Lab reports
5. In class work
6. Group project

Acquired Abilities²:

1. Select appropriate types of materials for engineering applications.(1-6)
2. Identify how microstructure is modified by processing and how properties are influenced by microstructure. (1-4)
3. Experimentally acquire the mechanical properties of engineering materials which influence material selection decisions and utilize the various testing methods for evaluating mechanical properties. (4)
4. Perform calculations related to equilibrium and non-equilibrium phase diagrams and discuss how thermal and mechanical processing influence, and can be used to control, the microstructure and properties of engineering materials. (1-5)
5. Evaluate how the environment can influence the structure and properties of engineering materials. (1-5)
6. Describe various types of material failure and to present procedures to avoid them. (1-5)

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Date of Latest Revision: 24 OCT 2001

¹ Letters in parenthesis refer to the [Program Objectives](#) of the [Mechanical Engineering Program](#).

² Numbers in parenthesis refer to the evaluation methods used to assess student performance.